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## **CLAIMS**

## What is claimed is:

- 1. A residue-free contact opening in a dielectric layer for a semiconductor device formed by a method comprising:
- providing a semiconductor substrate having a conductive pad;
  - forming said dielectric layer over said semiconductor substrate and said conductive pad with at least one opening extending from an upper dielectric layer surface to said conductive pad and including a residue residing within said at least one opening;
  - applying nitric acid within said at least one opening; and subsequently applying a phosphoric acid containing solution within said at least one opening.
  - 2. A contact within a residue-free opening in a dielectric layer for a semiconductor device formed by a method comprising: providing a semiconductor substrate having a conductive pad; forming said dielectric layer over said semiconductor substrate and said conductive pad with at least one opening extending from an upper dielectric layer surface to said conductive pad, and wherein a residue resides within said at least one opening;

applying a nitric acid within said at least one opening;
subsequently applying a phosphoric acid containing solution within said at least one opening; and
disposing conductive material within said at least one opening.

3. A residue-free contact opening in a dielectric layer and a barrier layer for a semiconductor device formed by a method comprising: providing a semiconductor substrate having a conductive pad; forming said barrier layer over said semiconductor substrate and said conductive pad;

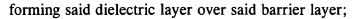
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forming a first via portion through said dielectric layer to expose a portion of said barrier layer, said formation of said first via portion forming an oxide polymer residue within said first via portion;

forming a second via portion through said exposed portion of said barrier layer, said formation of said second via portion forming a metal polymer residue within said first and second via portions;

applying nitric acid within said first and second via portions to remove said metal polymer residue; and

subsequently applying a phosphoric acid containing solution within said first via portion to remove said oxide polymer residue.

4. A residue-free contact opening in a dielectric layer and a barrier layer for a semiconductor device, formed by a method comprising:

providing a semiconductor substrate having a conductive pad;

forming said barrier layer over said semiconductor substrate and said conductive pad; forming said dielectric layer over said barrier layer;

forming a first via portion through said dielectric layer to expose a portion of said barrier layer, said formation of said first via portion forming an oxide polymer residue within said first via portion;

applying a phosphoric acid containing solution within said first via portion to remove said oxide polymer residue;

forming a second via portion through said exposed portion of said barrier layer, said formation of said second via portion forming a metal polymer residue within said first and second via portions; and

applying a pitric acid containing solution within said first and second via portions to remove said metal polymer residue.

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5. A residue-free contact opening in a dielectric layer for a semiconductor device formed by a method comprising:
providing a semiconductor substrate having a conductive pad;
forming said dielectric layer over said semiconductor substrate and said conductive pad with at least one opening extending from an upper dielectric layer surface to said conductive pad, and wherein a residue resides within said at least one opening; applying nitric acid within said at least one opening; and subsequently applying a phosphoric acid solution including a fluorine containing component within said at least one opening.

6. A contact within a residue-free opening in a dielectric layer for a semiconductor device formed by a method comprising:
providing a semiconductor substrate having a conductive pad;
forming said dielectric layer over said semiconductor substrate and said conductive pad with at least one opening extending from an upper dielectric layer surface to said conductive pad, and wherein a residue resides within said at least one opening;
applying a nitric acid within said at least one opening;
subsequently applying a phosphoric acid solution, including a fluorine containing component, within said at least one opening; and
disposing conductive material within said at least one opening.

7. A method of fabricating a contact opening in a dielectric layer and a barrier layer for a semiconductor device, comprising:

providing a semiconductor substrate having a conductive pad;
forming said barrier layer over said semiconductor substrate and said conductive pad;
forming said dielectric layer over said barrier layer;
forming a first via portion through said dielectric layer to expose a portion of said barrier layer, said formation of said first via portion forming an oxide polymer residue within said first via portion;

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forming a second via portion through said exposed portion of said barrier layer, said formation of said second via portion forming a metal polymer residue; applying nitric acid within said first and second via portions to remove said metal polymer residue; and

subsequently applying a phosphoric acid solution including a fluorine containing component within said first via portion to remove said oxide polymer residue.

8. A residue-free contact opening in a dielectric layer and a barrier layer for a semiconductor device formed by a method comprising:

providing a semiconductor substrate having a conductive pad;

forming said barrier layer over said semiconductor substrate and said conductive pad;

forming said dielectric layer over said barrier layer;

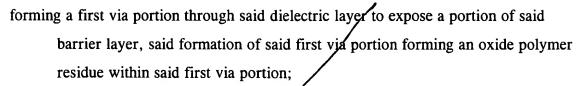
forming a first via portion through said dielectric layer to expose a portion of said barrier layer, said formation of said first via portion forming an oxide polymer residue within said first via portion;

forming a second via portion through said exposed portion of said barrier layer, said formation of said second via portion forming a metal polymer residue within said first and second via portions;

applying nitric acid within said/first and second via portions to remove said metal polymer residue; and

subsequently applying a phosphoric acid solution including a fluorine containing component within said first via portion to remove said oxide polymer residue.

9. A residue-free contact opening in a dielectric layer and a barrier layer for a semiconductor device formed by a method comprising: providing a semiconductor substrate having a conductive pad; forming said barrier layer over said semiconductor substrate and said conductive pad; forming said dielectric layer over said barrier layer;



- applying a solution including a fluorine containing component within said first via portion to remove said oxide polymer residue;
- forming a second via portion through said exposed portion of said barrier layer, said formation of said second via portion forming a metal polymer residue within said first and second via portions; and
- applying nitric acid within said first via and second via portions to remove said metal polymer residue.